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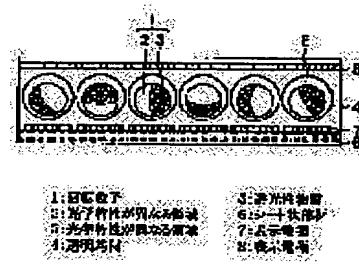
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(54) SHEET TYPE DISPLAY DEVICE AND METHOD OF MANUFACTURING FOR THE SAME

(57)Abstract:

PROBLEM TO BE SOLVED: To improve display quality by preventing the intrusion of air bubbles into cavities relating to a sheet type display device and a method of manufacturing for the same.

SOLUTION: The critical surface tension of the rotary particle 1 material and transparent base material 4 of the sheet type display device consisting of the rotary particles 1 having regions 2 and 3 varying in optical characteristics from each other, the transparent base material 4 for dispersing the rotary particles 1 and translucent materials 5 for packing the cavities formed around the rotary particles 1 is specified to the surface tension of the translucent materials 5 or above.



1:回転粒子
 2:光学特性が異なる領域
 3:光散乱による空洞
 4:透明基板
 5:遮光材
 6:シート
 7:表示装置
 8:表示電極

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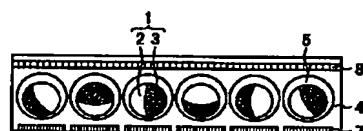
(54)【発明の名称】 シート型表示装置及びその製造方法

(57)【要約】

【課題】 シート型表示装置及びその製造方法に関し、キャビティ中に気泡が混入することを防止して表示画質を向上する。

【解決手段】 互いに光学的特性が異なる領域2、3を有する回転粒子1と、回転粒子1を分散する透明基材4、回転粒子1の周囲に形成されたキャビティを充填する透光性物質5とからなるシート型表示装置の回転粒子1材料及び透明基材4の臨界表面張力を、透光性物質5の表面張力以上とする。

本発明の原理的構成の説明図



1:回転粒子
2:光学特性が異なる領域
3:光学特性が異なる領域
4:透明基材
5:透光性物質
6:シート状基材
7:表示電極
8:表示電極

【特許請求の範囲】

【請求項1】互いに光学的特性が異なる領域を有する回転粒子と、前記回転粒子を分散する透明基材、前記回転粒子の周囲に形成されたキャビティを充填する透光性物質とからなるシート型表示装置において、前記回転粒子及び透明基材の臨界表面張力が、透光性物質の表面張力以上であることを特徴とするシート型表示装置。

【請求項2】上記キャビティが、上記回転粒子を分散した透明基材を膨潤することによって構成されたキャビティ或いは上記透明基材に機械加工によって形成したキャビティのいずれかであることを特徴とする請求項1記載のシート型表示装置。

【請求項3】上記透明基材がシリコーンゴムによって構成されるとともに、上記透光性物質がシリコーンオイルであることを特徴とする請求項1または2に記載のシート型表示装置。

【請求項4】互いに光学的特性が異なる領域を有する回転粒子を液状透明基材に分散させたのち、シート状部材に塗布して固化させる工程、前記固化した透明基材を透光性液体中に浸漬して膨潤されることによって前記回転粒子の周囲に前記透光性液体で充填されたキャビティを形成する工程を有するシート型表示装置の製造方法において、前記回転粒子の臨界表面張力が前記液状透明基材の表面張力以上になるように予め材料選択を行なうことを特徴とするシート型表示装置の製造方法。

【請求項5】シート状透明基材に複数の凹部を形成する工程、前記凹部に互いに光学的特性が異なる領域を有する回転粒子を分散させた透光性液体を充填する工程、前記シート状透明基材の凹部を設けた面にシート状透明フィルムを貼り合わせる工程を有するシート型表示装置の製造方法において、前記回転粒子及びシート状透明基材の臨界表面張力が、前記透光性液体の表面張力以上になるように予め材料選択を行なったことを特徴とするシート型表示装置の製造方法。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明はシート型表示装置及びその製造方法に関するものであり、特に、エレクトリックペーパーと呼ばれるディスプレーシートにおいて、対比色の2つの半球体を一体化させた2色ボールを透明基材中に気泡を発生させることなく回転自在に内包させるための材料選択に特徴のあるシート型表示装置及びその製造方法に関するものである。

【0002】

【従来の技術】近年、情報機器の普及に伴い、エレクトリックペーパー、ペーパーライクディスプレイ、ディジタルペーパなどと呼ばれ、一対の電極板間に表示層を挟み、この電極間に電界を印加することによって光学的吸収もしくは光学的反射を変化させて像表示を行うシート型表示装置が注目を集めている。

【0003】この様なシート型表示装置を構成する光学的反射もしくは光学的吸収を変化させる表示層を構成する微小要素として、電気泳動粒子を分散させた溶媒を着色し、この溶媒を内包したマイクロカプセル（必要ならば、特開平1-86116号公報参照）、色と電気的特性の双方が異なる半球を合わせた回転体、即ち、2色ボールを内包したマイクロカプセル（必要ならば、特開平6-226875号公報、特開平8-234686号公報、米国特許第4,126,854号明細書、或いは、米国特許第4,143,103号明細書参照）、或いは、2色性色素とスマートチック液晶を含む液晶／高分子複合膜が知られている。

【0004】これらの素子の場合には、メモリー性を有し、電源がなくとも像情報を保持することができ、これらの素子を用いて表示装置を構成する場合には、これらの素子を電極を形成したPET（ポリエンチレンテレフタレート）シート上に塗布すれば良いので、薄くて、軽く、持ち運び可能な可撓性を有する表示装置となり、また、反射型表示装置であるため、紙の代替として期待されている。

【0005】特に、上述の米国特許第4,126,854号明細書、或いは、米国特許第4,143,103号明細書に記載された2色ボールを用いた表示装置は、他の方式に比べて優れたコントラスト特性を示すディスプレイとして知られているので、ここで、図8を参照して、従来の2色ボールを用いたエレクトリックペーパの一例を説明する。

【0006】図8参照

図8は従来の2色ボールを用いたエレクトリックペーパの概念的構成図であり、表示電極58を形成したPETフィルム56に、黒色半球52と白色半球53とを一体化した個々の直径が $10\text{ }\mu\text{m} \sim 300\text{ }\mu\text{m}$ 程度の2色ボール51を分散させたホスト層となるシリコーンゴム54を塗布したのち、シリコーンゴム54を固化させ、次いで、シリコーンオイル中に浸漬してシリコーンゴム54を膨潤させることによって2色ボール51の近傍に2色ボール51を内包する球形の空洞を自己形成したのち、表示電極59を形成したPETフィルム55を、ストライプ状の表示電極58と表示電極59とが互いに略直交するように貼り付けるものであり、膨潤によって形成された空洞内は誘電体液であるシリコーンオイル57で満たされる。

【0007】この場合、2色ボール51全体では電気的に中性であるものの、黒色半球52は正に帯電し、一方、白色半球53は負に帯電しているので、表示電極58、59間に電圧を印加すると、その電界の極性に応じて2色ボール51はシリコーンオイル57で満たされた空洞内で回転して、観測者に所定の情報を表示するものである。即ち、2色ボール51自身も誘電体であり、巨視的には電気的に中性であるが、微視的には相反する極

性の電荷の2層からなる電気2重層である。

【0008】このエレクトリックペーパーは、紙に似ており、紙のように周辺光調整作用を有しているので、周囲光が明るくなるにつれて反射光が強くなり、このエレクトリックペーパーは一層見えやすくなる。

【0009】また、紙のように可撓性があり、紙のように持ち運ぶことができ、さらに、表示電極58, 59に電圧を印加することによって、紙のように書き込みやコピーすることが可能になる。

【0010】この様な2色ボール、即ち、回転粒子の製造方法としては各種の方法が提案されており、例えば、カルナバワックスにカーボンブラックを添加したものと、酸化チタンを添加したものからなる色の異なる2種類の溶融したワックスを結合させ、表面張力により球形化したのち固化させて2色ボールとする方法（必要ならば、米国特許第5, 262, 098号明細書参照）がある。

【0011】また、ガラス或いは樹脂からなる光透過性の粒子の片側の半球表面に金属、カーボンブラック、或いは、硫化アンチモン等を蒸着・塗布する方法（必要ならば、特開平11-85067号公報或いは特開平11-85068号公報参照）、或いは、酸化亜鉛や親水性高分子等の光導電性材料からなるボールにトナーやハロゲン化銀を半球表面に選択的に付着させる方法（必要ならば、特開平11-85069号公報或いは特開平11-161206号公報参照）等が知られている。

【0012】また、上記の製造方法以外にも、樹脂、ワックス、或いは、着色剤等の回転粒子を構成する材料を様々に変え、2色ボールを構成する2つの異色半球の極性の差を大きくする等によって2色ボールの回転を低エネルギーで行い、高解像で且つ早応答性で良好な表示を行なうことができるよう試みられている。

【0013】さらに、この様な回転粒子としては、上述の2色ボール以外に、3色または4色に塗り分けた多色化に対応した多色ボールも提案されている。

【0014】この様な回転粒子を構成する主構成材料としては、ポリスチレン、ポリアクリル、ポリエチレン等の樹脂や、ガラス等の無機材料でも良いが、製造容易性の観点から、形状の制御性、色分け、帯電制御性の容易な物質が望ましい。

【0015】また、回転粒子の回転・停止等の運動制御性の観点からは、帯電制御性、形状や大きさの制御性の容易さに加え、比重も重要になり、さらに、化学的安定性も重要であり、特に、シート型表示装置を上述のように膨潤を利用して製造する場合、シリコーンオイル等の透光性液体に不溶或いは無視し得るなど相互作用の小さな物質である必要がある。

【0016】この様な相互作用の小さな物質としては、分子量が50000以下で、比重が0.70~1.20であるワックス状物質が好適であり、例えば、ステアリ

ン酸、パルミチン酸、ミリスチン酸、ラウリン酸等の高級脂肪酸類、ステアリン酸アルミニウム、ステアリン酸カリウム、パルミチン酸亜鉛等の高級脂肪酸金属塩類、水添ヒマシ油、ココア脂、メチルヒドロキシステアレート、グリセロールモノヒドロキシステアレート等の高級脂肪酸の誘導体類、木口ウ、蜜口ウ、カルナバワックス、マイクロクリスタリンワックス、パラフィンワックス等のワックス類、ポリエチレン、ポリプロピレン、エチレン-酢酸ビニル共重合体、エチレン-ビニルアルキルエーテル等の低分子量のオレフィン重合体及び共重合体等が挙げられる。

【0017】これらの物質を主構成材料とする回転粒子を、基材、例えば、シリコーンゴム等のエラストマー（elastomer）に分散してキャビティを構成することによって上述のシート型表示装置が得られる。

【0018】

【発明が解決しようとする課題】しかし、上記の2色ボールを用いたシート型表示装置を製造し、表示電極に電圧を印加して2色ボールを回転させて表示を行なったところ、乱反射して色の認識が困難なものや、回転挙動の不安定な2色ボールが多数発生し、表示画質が低下するという問題が発生した。

【0019】この様な表示画質の低下の原因を鋭意検討したところ、シート中の一部のキャビティ内に気泡が混入し、この気泡が2色ボールの回転を阻害し、また、乱反射の原因になっていることを解明した。

【0020】したがって、本発明は、キャビティ中に気泡が混入することを防止して表示画質を向上することを目的とする。

【0021】

【課題を解決するための手段】ここで、図1を参照して、本発明における課題を解決するための手段を説明するが、図における符号7, 8は表示電極である。

図1参照

上述の目的を達成するために、本発明は、互いに光学的特性が異なる領域2, 3を有する回転粒子1と、回転粒子1を分散するシリコーンゴム、特に、付加反応によって架橋して固体化するシリコーンゴム等の透明基材4、回転粒子1の周囲に形成されたキャビティを充填するシリコーンオイル等の透光性物質5とからなるシート型表示装置において、回転粒子1材料及び透明基材4の臨界表面張力が、透光性物質5の表面張力以上であることを特徴とする。

【0022】この様に、シート型表示装置を構成する回転粒子1材料及び透明基材4の臨界表面張力と、透光性物質5の表面張力の関係を、回転粒子1材料及び透明基材4の臨界表面張力 \geq 透光性物質5の表面張力とすることによって、材料相互間のなじみ性が高まり、回転粒子1及び透明基材4が透光性物質5を弾くことがなく、したがって、分散或いは充填の工程で大気が混入すること

がないので、キャビティに気泡が混入することがない。【0023】この様なシート型表示装置は、互いに光学的特性が異なる領域2、3を有する回転粒子1を液状透明基材4に分散させたのち、シート状部材6に塗布して固化させ、次いで、固化した透明基材4を透光性液体中に浸漬して膨潤させることによって回転粒子1の周囲に前記透光性液体で充填されたキャビティを形成して構成しても良く、この場合には、回転粒子1の臨界表面張力が液状透明基材4の表面張力以上になるように予め材料選択を行なうことによって、回転粒子1を液状透明基材4に分散させる工程で大気が混入することがない。

【0024】なお、回転粒子1の臨界表面張力が液状透明基材4の表面張力より小さい場合には、回転粒子1の表面を液状透明基材4の表面張力以上の表面張力の透光性物質5で予め覆ったのち分散させれば良く、それによって、回転粒子1の臨界表面張力の小ささを補うことができる。

【0025】また、シート型表示装置は、シート状透明基材に複数の凹部を形成したのち、凹部に互いに光学的特性が異なる領域2、3を有する回転粒子1を分散させた透光性液体を充填し、次いで、シート状透明基材の凹部を設けた面にシート状透明フィルムを貼り合わせて構成しても良く、この場合には、回転粒子1及びシート状透明基材の臨界表面張力が、前記透光性液体の表面張力以上になるように予め材料選択を行なうことによって、回転粒子1を分散した透光性液体を凹部に充填する工程で大気が混入することがない。

【0026】また、液状透明基材4としては、シリコーンオイルが好適であり、特に、付加反応によって架橋して固体化するシリコーンゴムが好適である。例えば、縮合反応によって固体化するシリコーンゴムの場合には、縮合反応の際に、アルコールやアセトン蒸気等が発生し、気泡の原因となる虞がある。

【0027】

【発明の実施の形態】ここで、図2乃至図4を参照して本発明の第1の実施の形態のシート型表示装置の製造方法を説明する。

図2 (a) 参照

まず、シート状透明基材となる2液性R T VシリコーンゴムK E 109(信越化学製商品名)からなる液状透明基材11に、粒径が10~300μm、より好適には、50~200μmの回転粒子12を分散したのち、表示電極14を形成するとともにSiO₂粒子を混入して不透明化したPETフィルム13上に塗布する。

【0028】この場合、回転粒子12としては、不飽和ポリエステル樹脂製、アクリル樹脂製、及び、ポリスチレン樹脂製の3種類の回転粒子を用意した。ここで、液状透明基材11の表面張力と回転粒子12の臨界表面張力を予め測定しておくものであり、2液性R T VシリコーンゴムK E 109の表面張力は21dynes/cm。

で、不飽和ポリエステル樹脂の臨界表面張力は43dynes/cm、アクリル樹脂の臨界表面張力は39dynes/cm、ポリスチレン樹脂の臨界表面張力は33dynes/cmであった。

【0029】ここで、回転粒子12の臨界表面張力、即ち、固体の表面張力の測定方法を図4を参照して説明する。

図4 (a) 参照

まず、被測定材料22をシート状に加工し、このシート状に加工した被測定材料22に表面張力が互いに異なる数種類の液体23を滴下してその接触角θを測定する。

【0030】図4 (b) 参照

次いで、測定した各接触角θを液体22の表面張力に対してプロットし、傾向外挿によってcosθ=1となる表面張力γを被測定材料23の臨界表面張力として定義するものである。

【0031】図2 (b) 参照

次いで、減圧雰囲気、例えば、0.95MPaの減圧雰囲気中で1分間脱泡処理したのち、室温において48時間放置して液状透明基材11を付加反応による架橋によって硬化させて透明基材15とする。この状態においては、回転粒子12の周囲には空隙は存在していない。なお、因に、硬化した透明基材15の臨界表面張力は25dynes/cmである。

【0032】図3 (c) 参照

次いで、このシートをシリコーンオイルSH200-20cS(東レダウコーニングシリコーン社製商品名)からなる透光性液体16中に24時間浸漬して、透明基材15を膨潤させる。この場合、回転粒子12は透光性液体16に対して不溶乃至は吸収性が極めて低いため、回転粒子12の周囲に空隙が形成され、この空隙に透光性液体16が入り込んで透光性液体17で満たされることになる。

【0033】図3 (d) 参照

次いで、ITOからなる透明共通電極19を設けた透明PETフィルム18を貼り合わせたのち、透明共通電極19に電源20を接続するとともに、表示電極14に対しては駆動回路21を介して電源20を接続することによってシート型表示装置の基本構成が完成するものであり、各表示電極14で所定の電位を印加することによって回転粒子12の回転を制御して所定を像表示を行う。

【0034】この様に製造したシート型表示装置について空隙を満たす透光性液体17中の気泡の有無、即ち、乱反射性及び回転阻害を調査した結果、いずれの場合も回転阻害及び乱反射は見られなかった。

【0035】また、回転粒子12として、臨界表面張力が22dynes/cmのポリフッ化ビニリデン樹脂を用いた場合には、回転阻害は見られなかったものの、乱反射が見られたので、上述の脱泡工程において、0.08

M P a 以上の高真空中で脱泡処理を行なうことによって乱反射は見られなくなった。

【0036】また、回転粒子12として、臨界表面張力が18.5 d y n e / c m のポリ4フッ化エチレン樹脂（P T F E）ポリフッ化ビニリデン樹脂を用いた場合には、回転阻害が見られ不適であったが、回転粒子12を液状透明基材11中に分散する過程で、回転粒子12を予め表面張力が21 d y n e / c m 以上の透光性液体中で浸漬して回転粒子12の表面を高表面張力膜で被覆し脱泡工程を高真空中で行なうことによって回転阻害が見られないようになった。

【0037】図5参照

図5は、上記の結果を纏めたものであり、比較のためにシート状透明基材としてP T F E フィルムを用い、このP T F E フィルムを機械加工により押し込み間隙からなる凹部を形成し、この凹部に回転粒子を分散したシリコーンオイルSH200-20cS（東レダウコーニングシリコーン社製商品名）からなる透光性液体を充填したのち、凹部を設けた側に新たなP T F E フィルムを貼り合わせた比較例（比較例3～7）も合わせて示しており、この場合の回転粒子として、上記の5種類の樹脂からなる回転粒子を用いた。この比較例3～7の場合には、全てにおいて回転阻害が見られた。

【0038】以上を臨界表面張力と表面張力との観点から考察すると、実施の形態と比較例1、2の対比からは、回転粒子12の臨界表面張力と液状透明基材11の表面張力との間には、回転粒子12の臨界表面張力 \geq 液状透明基材11の表面張力の関係が必要であり、この関係を満たすことによって、回転粒子12の分散工程において、回転粒子12が液状透明基材を弾くことがないことで気泡が混入することがなくなる。

【0039】但し、上述のように、実施の形態④の様に回転粒子12の臨界表面張力が液状透明基材11の表面張力より若干大きい程度の場合には気泡が混入しやすくなるので、脱泡処理を高真空中で行なう必要があり、また、実施の形態⑤の様に回転粒子12の臨界表面張力が液状透明基材11の表面張力より小さい場合には、予め高表面張力膜で被覆する必要がある。

【0040】なお、比較例3～7の場合には、シート状透明基材の表面張力 $<$ 透光性液体の表面張力となっているので、P T F E シートに設けた凹部を回転粒子を分散したシリコーンオイルで充填する際に、大気が混入するため、キャビティに気泡が混入すると考えられる。

【0041】次に、図6及び図7を参照して、本発明の第2の実施の形態のシート型表示装置の製造工程を説明する。

図6 (a) 参照

まず、表示電極32を形成したS i O₂ 粒子を分散させたP E T フィルム31上に臨界表面張力が20 d y n e / c m 以上の熱可塑性樹脂フィルム33を貼り付け、機

械的加工により押し込み間隙からなる凹部34を形成する。

【0042】図6 (b) 参照

次いで、臨界表面張力が20 d y n e / c m 以上の回転粒子、例えば、臨界表面張力が43 d y n e / c m の不飽和ポリエステル樹脂からなる回転粒子35を分散させたシリコーンオイルSH200-20cS（東レダウコーニングシリコーン社製商品名）からなる透光性液体36を滴下し、凹部34を回転粒子35及び透光性液体36で充填する。

【0043】図7 (c) 参照

次いで、高減圧雰囲気中で臨界表面張力が20 d y n e / c m 以上の熱可塑性樹脂フィルム37を貼り付けて凹部34を密閉したのち、熱可塑性樹脂フィルム37上に共通透明電極39を形成したP E T フィルム38を貼り合わせる。

【0044】図7 (d) 参照

次いで、透明共通電極39に電源40を接続するとともに、表示電極32に対しては駆動回路41を介して電源40を接続することによってシート型表示装置の基本構成が完成するものであり、各表示電極32で所定の電位を印加することによって回転粒子35の回転を制御して所定を像表示を行なう。

【0045】この第2の実施の形態においては、透明基材の膨潤工程を用いていないので、空気の混入機会は、①回転粒子35の分散工程、②透光性液体36の充填工程、及び、③熱可塑性樹脂フィルム37の貼り付け工程となるが、回転粒子の臨界表面張力 $>$ 透光性液体の表面張力であるので、①回転粒子35の分散工程において空気が混入することがない。

【0046】また、熱可塑性樹脂フィルム37の臨界表面張力 $>$ 透光性液体の表面張力であるので、②透光性液体36の充填工程及び③熱可塑性樹脂フィルム37の貼り付け工程においても、空気が混入することがなく、特に、③熱可塑性樹脂フィルム37の貼り付け工程を高減圧雰囲気下で行なっているので空気が混入することがない。

【0047】以上、本発明の各実施の形態を説明してきたが、本発明は各実施の形態に記載した構成及び条件に限られるものではなく、各種の変更が可能である。例えば、上記の各実施の形態においては回転粒子の色について特に言及していないが、必要とする表示色に応じて主構成材料中に着色剤等を混入して2色ボール或いは多色ボールを形成すれば良いものであり、その製造方法は、上述の公知の製造方法を用いても良いし、他の公知の製造方法を用いても良いものであり、製造方法に制限はないものである。

【0048】また、回転粒子を形成する主構成材料は実施の形態に記載した材料に限られるものではなく、上述の従来例において説明した各種の材料を用いることがで

きるものであり、透光性液体に対する不溶性及び液状透明基材に対する臨界表面張力の関係に基づいて選択すれば良いものである。

【0049】また、上記の各実施の形態においては、下側のシートを SIO_2 等を分散した反射性の PET フィルムで構成しているが、この様な構成に限られるものではなく、透明な PET フィルムを用い、表示電極を形成する側と反対側に厚さが $80 \mu m$ 程度の白濁した不透明な合成紙（例えば、合成紙ユポ：王子油化製商品名）を貼る付けても良いものである。

【0050】また、上記の第 1 の実施の形態においては、回転粒子を分散した液状透明基材を表示電極を形成した PET フィルム上に塗布しているが、この様な構成に限られるものではなく、テフロン（登録商標）製フィルム上に、回転粒子を分散した液状透明基材を塗布し、脱泡、固化、膨潤処理を行なったのち、テフロン製フィルムを剥離し、次いで、表示電極を形成した一対の PET フィルムで透明基材は挟んで貼り合わせても良いものである。

【0051】また、上記の第 2 の実施の形態においては、熱可塑性樹脂フィルムを表示電極を形成した PET フィルム上に貼り付けているが、この様な構成に限られるものではなく、テフロン製フィルム上に、熱可塑性樹脂フィルムを貼り付け、凹部形成、回転粒子を分散した透光性液体の充填、熱可塑性樹脂フィルムによる封止を行なったのち、テフロン製フィルムを剥離し、次いで、表示電極を形成した一対の PET フィルムで透明基材は挟んで貼り合わせても良いものである。

【0052】また、上記の各実施の形態においては、マトリクス状の表示電極と共通電極を用い、マトリクス状表示電極を駆動回路によって選択駆動するようにしているが、PET フィルム自体に TFT 等のアクティブ素子を設けてアクティブマトリクス型エレクトリックペーパとしても良いものである。

【0053】或いは、図 8 に示した従来例のように、互いに直交するストライプ状表示電極を対向させた単純マトリクス型で構成しても良いものである。

【0054】また、上記の第 2 の実施の形態においては、回転粒子の材質を一種類しか示していないが、上記の第 2 の実施の形態と同様に各種の材質の回転粒子を用いることができるものである。但し、臨界表面張力が小さな材質を用いる場合には、脱泡処理をより高真空下で行なう必要があり、或いは、回転粒子の表面を予め透光性液体の表面張力以上の表面張力を有する被膜で被覆しておく必要がある。

【0055】ここで、再び、図 1 を参照して、本発明の詳細な特徴を説明する。

図 1 参照

（付記 1）互いに光学的特性が異なる領域 2、3 を有する回転粒子 1 と、前記回転粒子 1 を分散する透明基材

4、前記回転粒子 1 の周囲に形成されたキャビティを充填する透光性物質 5 とからなるシート型表示装置において、前記回転粒子 1 及び透明基材 4 の臨界表面張力が、透光性物質の表面張力以上であることを特徴とするシート型表示装置。

（付記 2）上記キャビティが、上記回転粒子 1 を分散した透明基材 4 を膨潤することによって構成されたキャビティ或いは上記透明基材 4 に機械加工によって形成したキャビティのいずれかであることを特徴とする付記 1 記載のシート型表示装置。

（付記 3）上記透明基材 4 がシリコーンゴムによって構成されるとともに、上記透光性物質 5 がシリコーンオイルであることを特徴とする付記 1 または 2 に記載のシート型表示装置。

（付記 4）上記シリコーンゴムが、付加反応によって架橋して固体化するシリコーンゴムであることを特徴とする付記 1 記載のシート型表示装置。

（付記 5）互いに光学的特性が異なる領域 2、3 を有する回転粒子 1 を液状透明基材 4 に分散させたのち、シート状部材 6 に塗布して固化させる工程、前記固化した透明基材 4 を透光性液体中に浸漬して膨潤させることによって前記回転粒子 1 の周囲に前記透光性液体で充填されたキャビティを形成する工程を有するシート型表示装置の製造方法において、前記回転粒子 1 の臨界表面張力が前記液状透明基材 4 の表面張力以上になるように予め材料選択を行なうことを特徴とするシート型表示装置の製造方法。

（付記 6）互いに光学的特性が異なる領域 2、3 を有する回転粒子 1 を液状透明基材 4 に分散させたのち、シート状部材 6 に塗布して固化させる工程、前記固化した透明基材 4 を透光性液体中に浸漬して膨潤させることによって前記回転粒子 1 の周囲に前記透光性液体で充填されたキャビティを形成する工程を有するシート型表示装置の製造方法において、前記回転粒子 1 の臨界表面張力が前記液状透明基材 4 の表面張力より小さい場合、予め前記回転粒子 1 の表面を前記液状透明基材 4 の表面張力以上の表面張力を有する透光性物質からなる皮膜で覆う工程を設けたことを特徴とするシート型表示装置の製造方法。

（付記 7）上記透光性物質が、キャビティに充填される透光性液体と同じ物質であることを特徴とする請求項 6 記載のシート型表示装置の製造方法。

（付記 8）シート状透明基材に複数の凹部を形成する工程、前記凹部に互いに光学的特性が異なる領域 2、3 を有する回転粒子 1 を分散させた透光性液体を充填する工程、前記シート状透明基材の凹部を設けた面にシート状透明フィルムを貼り合わせる工程を有するシート型表示装置の製造方法において、前記回転粒子 1 及びシート状透明基材の臨界表面張力が、前記透光性液体の表面張力以上になるように予め材料選択を行なったことを特徴

とするシート型表示装置の製造方法。

【0056】

【発明の効果】本発明によれば、回転粒子の臨界表面張力、透光性液体の表面張力、液状透明基材の表面張力、或いは、透明基材の臨界表面張力が所定の関係を満たすように各材料を選択しているので、回転粒子が回転するキャビティに気泡が混入することがなく、気泡による回転阻害及び乱反射が生ずることがないので、表示品質に優れたシート型表示装置の再現性良く製造することができ、それによって、シート型表示装置の低コスト化、高品質化に寄与するところが大きい。

【図面の簡単な説明】

【図1】本発明の原理的構成の説明図である。

【図2】本発明の第1の実施の形態のシート型表示装置の途中までの製造工程の説明図である。

【図3】本発明の第1の実施の形態のシート型表示装置の図2以降の製造工程の説明図である。

【図4】臨界表面張力の測定方法の説明図である。

【図5】本発明の第1の実施の形態における表示特性の説明図である。

【図6】本発明の第2の実施の形態のシート型表示装置の途中までの製造工程の説明図である。

【図7】本発明の第2の実施の形態のシート型表示装置の図6以降の製造工程の説明図である。

【図8】従来のシート型表示装置の概略的要部断面図である。

【符号の説明】

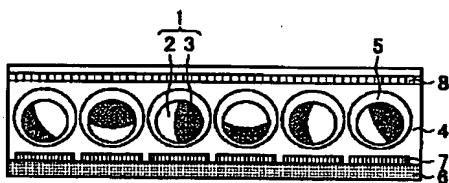
- 1 回転粒子
- 2 光学的特性が異なる領域
- 3 光学的特性が異なる領域
- 4 透明基材
- 5 透光性物質
- 6 シート状部材
- 7 表示電極

8 表示電極

- 1 1 液状透明基材
- 1 2 回転粒子
- 1 3 P E T フィルム
- 1 4 表示電極
- 1 5 透明基材
- 1 6 透光性液体
- 1 7 透光性液体
- 1 8 透明P E T フィルム
- 1 9 透明共通電極
- 2 0 電源
- 2 1 駆動回路
- 2 2 被測定材料
- 2 3 液体
- 3 1 P E T フィルム
- 3 2 表示電極
- 3 3 熱可塑性樹脂フィルム
- 3 4 凹部
- 3 5 回転粒子
- 3 6 透光性液体
- 3 7 熱可塑性樹脂フィルム
- 3 8 P E T フィルム
- 3 9 透明共通電極
- 4 0 電源
- 4 1 駆動回路
- 5 1 2色ボール
- 5 2 黒色半球
- 5 3 白色半球
- 5 4 シリコーンゴム
- 30 5 5 P E T フィルム
- 5 6 P E T フィルム
- 5 7 シリコーンオイル
- 5 8 表示電極
- 5 9 表示電極

【図1】

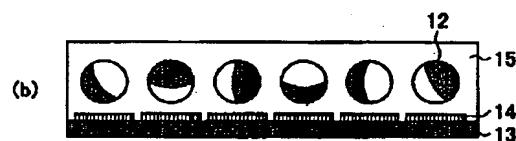
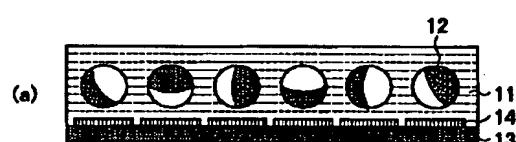
本発明の原理的構成の説明図



1:回転粒子
2:光学特性が異なる領域
3:光学特性が異なる領域
4:透明基材
5:透光性物質
6:シート状部材
7:表示電極
8:表示電極

【図2】

本発明の第1の実施の形態のシート型表示装置の途中までの製造工程の説明図



11:液状透明基材
12:回転粒子
13:PETフィルム
14:表示電極
15:透明基材

【図5】

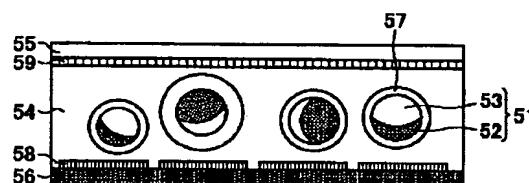
本発明の第1の実施の形態における表示特性の説明図

	基材	表面張力	付加処理	回転粒子	表面張力	結果
実施の形態①	シリコーンゴム	25		不飽和ポリエチル樹脂	43	○
実施の形態②	シリコーンゴム	25		アクリル樹脂	39	○
実施の形態③	シリコーンゴム	25		ポリスチレン樹脂	33	○
比較例①	シリコーンゴム	25		ポリフッ化ビニリデン樹脂	22	△
実施の形態④	シリコーンゴム	25	脱泡	ポリフッ化ビニリデン樹脂	22	○
比較例②	シリコーンゴム	25		PTFE	18.5	×
実施の形態⑤	シリコーンゴム	25	被覆	PTFE	18.5	○
比較例③	PTFE	18.5		不飽和ポリエチル樹脂	43	×
比較例④	PTFE	18.5		アクリル樹脂	39	×
比較例⑤	PTFE	18.5		ポリスチレン樹脂	33	×
比較例⑥	PTFE	18.5		ポリフッ化ビニリデン樹脂	22	×
比較例⑦	PTFE	18.5		PTFE	18.5	×

(但し、シリコーンオイルの表面張力は20dyne/cm)

【図8】

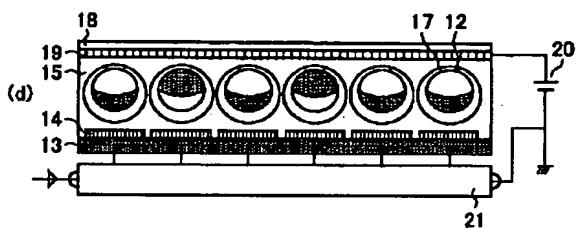
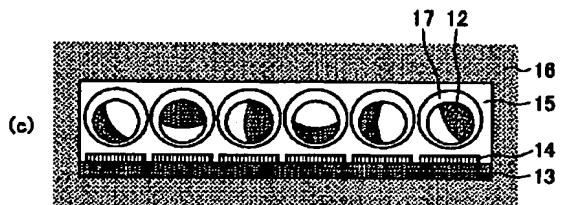
従来のシート型表示装置の概略的要部断面図



51:2色ボール
52:黒色半球
53:白色半球
54:シリコーンゴム
55:PETフィルム
56:シリコーンオイル
57:表示電極
58:表示電極
59:表示電極

【図3】

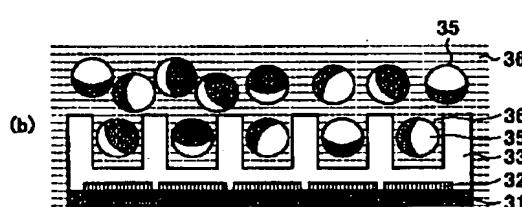
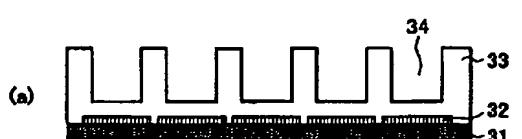
本発明の第1の実施の形態のシート型表示装置の図2以降の製造工程の説明図



12:回転粒子	17:透光性液体
13:PETフィルム	18:PETフィルム
14:表示電極	19:透明共通電極
15:透明基材	20:電源
16:透光性液体	21:駆動回路

【図6】

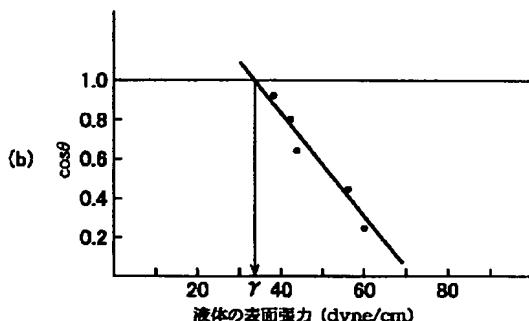
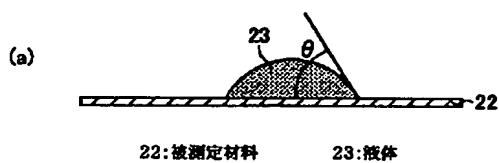
本発明の第2の実施の形態のシート型表示装置の途中までの製造工程の説明図



31:PETフィルム	34:凹部
32:表示電極	35:回転粒子
33:熱可塑性樹脂フィルム	36:透光性液体

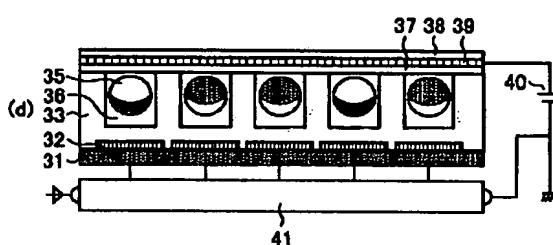
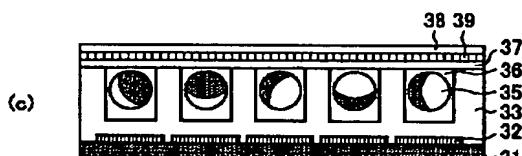
【図4】

臨界表面張力の測定方法の説明図



【図7】

本発明の第2の実施の形態のシート型表示装置の図6以降の製造工程の説明図



31:PETフィルム	37:熱可塑性樹脂フィルム
32:表示電極	38:PETフィルム
33:熱可塑性樹脂フィルム	39:共通透明電極
34:回転粒子	40:電源
35:透光性液体	41:駆動回路

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CLAIMS

[Claim(s)]

[Claim 1] The sheet mold display with which critical surface tension of said rotation particle and a transparency base material is characterized by being more than the surface tension of the translucency matter in the sheet mold display which consists of translucency matter filled up with the cavity formed in the perimeter of the rotation particle which has the field where optical properties differ mutually, and the transparency base material which distributes said rotation particle and said rotation particle.

[Claim 2] The sheet mold display according to claim 1 with which the above-mentioned cavity is characterized by being either of the cavities formed in the cavity or the above-mentioned transparency base material constituted by swelling the transparency base material which distributed the above-mentioned rotation particle by machining.

[Claim 3] The sheet mold display according to claim 1 or 2 characterized by the above-mentioned translucency matter being silicone oil while the above-mentioned transparency base material is constituted by silicone rubber.

[Claim 4] After making a liquefied transparency base material distribute the rotation particle which has the field where optical properties differ mutually, In the manufacture approach of a sheet mold display of having the process which applies to a sheet-like member and it is made solidifying, and the process which forms the cavity filled up into the perimeter of said rotation particle with said translucency liquid by being immersed into a translucency liquid and making said solidified transparency base material swelling The manufacture approach of the sheet mold display characterized by performing ingredient selection beforehand so that the critical surface tension of said rotation particle may become more than the surface tension of said liquefied transparency base material.

[Claim 5] The process which forms two or more crevices in a sheet-like transparency base material, the process filled up with the translucency liquid which made said crevice distribute the rotation particle which has the field where optical properties differ mutually, In the manufacture approach of a sheet mold display of having the process which sticks a sheet-like bright film on the field in which the crevice of said sheet-like transparency base material was established The manufacture approach of the sheet mold display characterized by performing ingredient selection beforehand so that the critical surface tension of said rotation particle and a sheet-like transparency base material may become more than the surface tension of said translucency liquid.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]**[0001]**

[Field of the Invention] This invention relates to the sheet mold display which has the description in the ingredient selection for making free the endocyst of the rotation of 2 color ball which made two hemispheres of a contrast color unify, without generating air bubbles in a transparency base material in the display sheet especially called an electric paper, and its manufacture approach about a sheet mold display and its manufacture approach.

[0002]

[Description of the Prior Art] In recent years, the sheet mold display which it is called a paper [an electric paper and]-like display, a digital paper, etc., a display layer is pinched between the electrode plates of a pair with the spread of information machines and equipment, and optical absorption or optical reflection is changed by impressing electric field to inter-electrode [this], and performs an image display attracts attention.

[0003] The microcapsule which colored the solvent which distributed the electrophoresis particle as a minute element which constitutes the display layer to which the optical reflection or optical absorption which constitutes such a sheet mold display is changed, and connoted this solvent (if required) Refer to JP,1-86116,A and the body of revolution which doubled the semi-sphere where the both sides of a color and electrical characteristics differ, i.e., the microcapsule which connoted 2 color ball, (if required) The liquid crystal / macromolecule bipolar membrane containing JP,6-226875,A, JP,8-234686,A, a U.S. Pat. No. 4,126,854 specification, referring to the U.S. Pat. No. 4,143,103 specification, or dichroic coloring matter and a smectic liquid crystal are known.

[0004] Since what is necessary is just to apply these components on the PET (polyene CHIREN terephthalate) sheet in which the electrode was formed in being able to hold image information and constitute an indicating equipment using these components , even if it has memory nature in the case of these components and there is no power source in it , it becomes the indicating equipment which has that it is thin and light and the flexibility which can be carry , and since it is a reflective mold indicating equipment , it is expect as an alternative of paper .

[0005] Since especially the indicating equipment using 2 color ball indicated by an above-mentioned U.S. Pat. No. 4,126,854 specification or an above-mentioned U.S. Pat. No. 4,143,103 specification is known as a display in which the contrast property which was excellent compared with other methods is shown, here explains an example of the electric paper using the conventional 2 color ball with reference to drawing 8 .

[0006] Drawing 8 reference drawing 8 is the notional block diagram of the electric paper using the conventional 2 color ball. After applying the silicone rubber 54 with which each diameter which united the black semi-sphere 52 and the white semi-sphere 53 with the PET film 56 in which the display electrode 58 was formed serves as a host layer who distributed 2 color ball 51 which is 10 micrometers - about 300 micrometers, After carrying out self-formation of the globular form cavity which connotes 2 color ball 51 near the 2 color ball 51 by solidifying silicone rubber 54, being immersed subsequently to the inside of silicone oil, and making silicone rubber 54 swell, The PET film 55 in which the display electrode 59 was formed is stuck so that stripe-

like the display electrode 58 and the display electrode 59 may carry out an abbreviation rectangular cross mutually, and the inside of the cavity formed of swelling is filled with the silicone oil 57 which is dielectric liquid.

[0007] In this case, it rotates in the cavity where 2 color ball 51 was filled with silicone oil 57 according to the polarity of that electric field when the electrical potential difference was impressed between the display electrode 58 and 59, since the black semi-sphere 52 was just charged although it was neutrality electrically in the 2 color ball 51 whole, and the white semi-sphere 53 was charged in negative on the other hand, and the information on predetermined to a watcher is displayed. That is, although 2 color ball 51 self is also a dielectric and neutrality electrically macroscopically, it is the electric duplex layer which consists of two-layer [of the polar charge which conflicts microscopically].

[0008] Since this electric paper resembles paper and it has the ambient light adjustment operation like paper, the reflected light becomes strong as an ambient light becomes bright, and this electric paper much more becomes easy to appear.

[0009] Moreover, it becomes possible by there being flexibility like paper, being able to carry like paper, and impressing an electrical potential difference to the display electrodes 58 and 59 further to write in and copy like paper.

[0010] Two kinds from which the color which consists of what various kinds of approaches are proposed as the manufacture approach of such a 2 color ball, i.e., a rotation particle, for example, added carbon black to carnauba wax, and a thing which added titanium oxide differs of fused waxes are combined, and there is the approach (if required, refer to U.S. Pat. No. 5,262,098 specification) of making solidify, after conglobating with surface tension, and using as 2 color ball.

[0011] Moreover, the method (if required, refer to JP,11-85069,A or JP,11-161206,A) of making a toner and a silver halide the semi-sphere front face of one side of the particle of light transmission nature which consists of glass or resin adhere [a semi-sphere front face] to the ball which consists of photoconductivity ingredients, such as the approach (refer to JP,11-85067,A or JP,11-85068,A if required) of vapor-depositing and applying a metal, carbon black, or an antimony sulfide, or a zinc oxide, a hydrophilic giant molecule, alternatively etc. is learned.

[0012] Moreover, the ingredient which constitutes rotation particles, such as resin, a wax, or a coloring agent; besides the above-mentioned manufacture approach is changed variously, and 2 color ball is rotated by low energy by enlarging the polar difference of two unique semi-spheres which constitute 2 color ball etc., it is high resolving, and it is tried so that a good display can already be performed by responsibility.

[0013] Furthermore, as such a rotation particle, the multicolor ball corresponding to multiple-colorizing distinguished by different color with in three colors or four colors in addition to above-mentioned 2 color ball is also proposed.

[0014] As a main component which constitutes such a rotation particle, although resin, such as polystyrene, the poly acrylic, and polyethylene, and inorganic materials, such as glass, are sufficient, the easy matter of the controllability of the viewpoint of manufacture ease to a configuration, classification by color, and an electrification controllability is desirable.

[0015] Moreover, from a viewpoint of movement controllabilities, such as rotation, a halt, etc. of a rotation particle, in addition to the ease of an electrification controllability and the controllability of a configuration or magnitude, specific gravity also needs to become important, and chemical stability also needs to be still more important, and when manufacturing a sheet mold display as mentioned above especially using swelling, it is necessary to be the matter with an interaction small insoluble into translucency liquids, such as silicone oil -- it can ignore.

[0016] As small matter of such an interaction, molecular weight is 50000 or less. The wax-like matter whose specific gravity is 0.70-1.20 is suitable. For example, higher fatty acids, such as stearin acid, a palmitic acid, a myristic acid, and a lauric acid Higher-fatty-acid metal salts, such as aluminum stearate, a stearin acid potassium, and palmitic-acid zinc, The derivatives of higher fatty acids, such as hydrogenation castor oil, cocoa fat, methyl hydroxystearate, and glycerol mono-hydroxystearate Haze wax, beeswax, carnauba wax, a micro crystallin wax, An olefin polymer, copolymers, etc. of low molecular weight, such as wax [, such as paraffin wax,],

Polyethylene, polypropylene, ethylene-vinyl acetate copolymer, and ethylene-vinyl alkyl ether, are mentioned.

[0017] An above-mentioned sheet mold display is obtained by distributing the rotation particle which makes these matter the main component to elastomers (elastomer), such as a base material, for example, silicone rubber etc., and constituting a cavity.

[0018]

[Problem(s) to be Solved by the Invention] However, when displayed by manufacturing the sheet mold indicating equipment using the above-mentioned 2 color ball, impressing an electrical potential difference to a display electrode, and rotating 2 color ball, it reflected irregularly, many what have difficult recognition of a color, and unstable 2 color balls of rotation behavior were generated, and the problem that display image quality deteriorated occurred.

[0019] When the cause of a fall of such display image quality was considered wholeheartedly, it solved air bubbles mixing in some cavities in a sheet, and these air bubbles checking rotation of 2 color ball, and having become the cause of scattered reflection.

[0020] Therefore, this invention aims at preventing that air bubbles mix into a cavity and improving display image quality.

[0021]

[Means for Solving the Problem] Although here explains The means for solving a technical problem in this invention with reference to drawing 1, the signs 7 and 8 in drawing are display electrodes.

In order to attain the drawing 1 referring-to-above-mentioned purpose, this invention The silicone rubber which distributes the rotation particle 1 which has the fields 2 and 3 where optical properties differ mutually, and the rotation particle 1, In the sheet mold display which consists of translucency matter 5, such as silicone oil filled up with the cavity formed in the perimeter of the transparency base materials 4, such as silicone rubber especially constructed for which a bridge and solidified by the addition reaction, and the rotation particle 1 Critical surface tension of rotation particle 1 ingredient and the transparency base material 4 is characterized by being more than the surface tension of the translucency matter 5.

[0022] Thus, by making into the surface tension of rotation particle 1 ingredient and the critical-surface-tension \geq translucency matter 5 of the transparency base material 4 relation of the critical surface tension of rotation particle 1 ingredient which constitutes a sheet mold display, and the transparency base material 4, and the surface tension of the translucency matter 5 Since the concordance nature between ingredients increases, and the rotation particle 1 and the transparency base material 4 do not flip the translucency matter 5, therefore atmospheric air does not mix at the process of distribution or restoration, air bubbles do not mix in a cavity.

[0023] After such a sheet mold display makes the liquefied transparency base material 4 distribute the rotation particle 1 which has the fields 2 and 3 where optical properties differ mutually, the sheet-like member 6 is made to apply and solidify it. Subsequently The cavity filled up into the perimeter of the rotation particle 1 with said translucency liquid by being immersed into a translucency liquid and making the solidified transparency base material 4 swell may be formed and constituted. In this case By performing ingredient selection beforehand so that the critical surface tension of the rotation particle 1 may become more than the surface tension of the liquefied transparency base material 4, atmospheric air does not mix the rotation particle 1 at the process which the liquefied transparency base material 4 is made to distribute.

[0024] In addition, when the critical surface tension of the rotation particle 1 is smaller than the surface tension of the liquefied transparency base material 4, the smallness of the critical surface tension of the rotation particle 1 can be compensated by it that what is necessary is just to make it distribute after covering the front face of the rotation particle 1 beforehand by the translucency matter 5 of the surface tension more than the surface tension of the liquefied transparency base material 4.

[0025] After a sheet mold display forms two or more crevices in a sheet-like transparency base material, it is filled up with the translucency liquid which made the crevice distribute the rotation particle 1 which has the fields 2 and 3 where optical properties differ mutually. Moreover, subsequently In the field in which the crevice of a sheet-like transparency base material was

established, a sheet-like bright film is stuck and may be constituted. In this case Atmospheric air does not mix the translucency liquid which distributed the rotation particle 1 at the process with which a crevice is filled up by performing ingredient selection beforehand so that the critical surface tension of the rotation particle 1 and a sheet-like transparency base material may become more than the surface tension of said translucency liquid.

[0026] Moreover, as a liquefied transparency base material 4, silicone oil is suitable and the silicone rubber especially constructed for which a bridge and solidified by the addition reaction is suitable. For example, in the case of the silicone rubber solidified by the condensation reaction, alcohol, an acetone steam, etc. occur in the case of a condensation reaction, and there is a possibility of becoming the cause of air bubbles in it.

[0027]

[Embodiment of the Invention] Here, with reference to drawing 2 thru/or drawing 4, the manufacture approach of the sheet mold display of the gestalt operation of the 1st of this invention is explained.

Drawing 2 (a) 3 **, first, after distributing the 50–200-micrometer rotation particle 12, while particle size forms more suitably 10–300 micrometers of display electrodes 14 in the liquefied transparency base material 11 which consists of 2 acidity-or-alkalinity RTV silicone rubber KE109 (trade name made from the Shin-etsu chemistry) used as a sheet-like transparency base material, it is SiO₂. It applies on the PET film 13 which mixed and opacified the particle.

[0028] In this case, as a rotation particle 12, the product made of an unsaturated polyester resin, the product made of acrylic resin, and three kinds of rotation particles made of polystyrene resin were prepared. The surface tension of the liquefied transparency base material 11 and the critical surface tension of the rotation particle 12 are measured beforehand, the surface tension of 2 acidity-or-alkalinity RTV silicone rubber KE109 was 21 dyne/cm here, and the critical surface tension of an unsaturated polyester resin was [the critical surface tension of 39 dyne/cm and polystyrene resin of the critical surface tension of 43 dyne/cm and acrylic resin] 33 dyne/cm.

[0029] Here, the measuring method of the critical surface tension of the rotation particle 12, i.e., solid surface tension, is explained with reference to drawing 4.

Drawing 4 (a) 3 **; first, some kinds of liquids 23 with which surface tension differs mutually are dropped at the measured ingredient 22 which processed the measured ingredient 22 in the shape of a sheet, and was processed in the shape of [this] a sheet, and that contact angle theta is measured.

[0030] Drawing 4 (b) 3 **, subsequently, each measured contact angle theta is plotted to the surface tension of a liquid 22, and the surface tension gamma set to cos theta=1 by inclination extrapolation is defined as critical surface tension of the measured ingredient 23.

[0031] Drawing 2 (b) Subsequently, after carrying out indirect desulfurization bubble processing for 1 minute in a reduced pressure ambient atmosphere, for example, the reduced pressure ambient atmosphere of 0.95MPa, it is left in a room temperature for 48 hours, the liquefied transparency base material 11 is stiffened according to bridge formation by the addition reaction, and it takes 3 ** for the transparency base material 15. In this condition, the opening does not exist in the perimeter of the rotation particle 12. In addition, incidentally the critical surface tension of the hardened transparency base material 15 is 25 dyne/cm.

[0032] Drawing 3 (c) Subsequently to the inside of the silicone oil SH200–20 translucency liquid 16 which consists of cS (Dow Corning Toray Silicone trade name), this sheet is immersed for 24 hours and the transparency base material 15 is made to swell 3 **. In this case, to the translucency liquid 16, since [insoluble or] absorptivity is very low, an opening will be formed in the perimeter of the rotation particle 12, the translucency liquid 16 will enter this opening, and the rotation particle 12 will be filled with the translucency liquid 17.

[0033] Drawing 3 (d) 3 **, subsequently, after sticking the transparency PET film 18 which formed the transparency common electrode 19 which consists of ITO, while connecting a power source 20 to the transparency common electrode 19 By connecting a power source 20 through the drive circuit 21 to the display electrode 14, the basic configuration of a sheet mold display is completed, by impressing predetermined potential with each display electrode 14, rotation of the

rotation particle 12 is controlled and an image display is performed for predetermined.

[0034] Thus, as a result of investigating the existence of the air bubbles in the translucency liquid 17 which fills an opening about the manufactured sheet mold display, i.e., scattered reflection nature, and rotation inhibition, as for rotation inhibition and scattered reflection, neither of the cases was seen.

[0035] Moreover, since scattered reflection was seen as a rotation particle 12 although rotation inhibition was not seen when critical surface tension used the polyvinylidene fluoride resin of 22 dyne/cm, in an above-mentioned degassing process, scattered reflection is no longer seen by performing degassing processing in the high vacuum of 0.08 or more MPas.

[0036] Moreover, although rotation inhibition was seen and it was unsuitable as a rotation particle 12 when critical surface tension used the Pori polytetrafluoroethylene resin (PTFE) polyvinylidene fluoride resin of 18.5 dyne/cm In the process which distributes the rotation particle 12 in the liquefied transparency base material 11, rotation inhibition ceased to be seen by immersing surface tension in the translucency liquid of 21 or more dyne/cm beforehand in the rotation particle 12, covering the front face of the rotation particle 12 with the high surface tension film, and performing a degassing process in a high vacuum.

[0037] Drawing 5 reference drawing 5 summarizes the above-mentioned result, and a PTFE film is used for it as a sheet-like transparency base material for a comparison. The crevice which pushes in this PTFE film by machining and consists of a gap is formed. After filling up this crevice with the translucency liquid which consists of silicone oil SH200-20cS (Dow Corning Toray Silicone trade name) which distributed the rotation particle, The example of a comparison (examples 3-7 of a comparison) which stuck a new PTFE film on the side which prepared the crevice is also doubled and shown, and the rotation particle which consists of five kinds of above-mentioned resin as a rotation particle in this case was used. In the case of these examples 3-7 of a comparison, rotation inhibition was seen in all.

[0038] When the above is considered from a viewpoint of critical surface tension and surface tension, from the gestalt of operation, and contrast of the examples 1 and 2 of a comparison Between the critical surface tension of the rotation particle 12, and the surface tension of the liquefied transparency base material 11 The relation of the surface tension of the critical-surface-tension \geq liquefied transparency base material 11 of the rotation particle 12 is required, and by filling this relation, in the distributed process of the rotation particle 12, since the rotation particle 12 does not flip a liquefied transparency base material, it is lost that air bubbles mix.

[0039] However, since it becomes easy to mix air bubbles like gestalt ** of operation as mentioned above in the case of extent a little with the larger critical surface tension of the rotation particle 12 than the surface tension of the liquefied transparency base material 11, it is necessary to perform degassing processing in a high vacuum and, and like gestalt ** of operation, when the critical surface tension of the rotation particle 12 is smaller than the surface tension of the liquefied transparency base material 11, it is necessary to cover with the high surface tension film beforehand.

[0040] In addition, in order that in the case of the examples 3-7 of a comparison atmospheric air may mix in case the crevice established in the PTFE sheet is filled up with the silicone oil which distributed the rotation particle since it has surface tension of the surface tension < translucency liquid of a sheet-like transparency base material, it is thought that air bubbles mix in a cavity.

[0041] Next, with reference to drawing 6 and drawing 7, the production process of the sheet mold display of the gestalt of operation of the 2nd of this invention is explained.

Drawing 6 (a) SiO₂ which formed the display electrode 32 first 3 ** Critical surface tension sticks the 20 dynes [/cm] or more thermoplastics film 33 on the PET film 31 which distributed the particle, and the crevice 34 which pushes in by mechanical processing and consists of a gap is formed.

[0042] Drawing 6 (b) 3 **, subsequently, critical surface tension trickles the rotation particle 36 of 20 or more dyne/cm, for example, the translucency liquid which consists of silicone oil SH200-20cS (Dow Corning Toray Silicone trade name) which critical surface tension made distribute the rotation particle 35 which consists of an unsaturated polyester resin of 43

dyne/cm, and a crevice 34 is filled up with the rotation particle 35 and the translucency liquid 36.

[0043] 3 **, subsequently, after critical surface tension's sticking the thermoplastics film 37 of 20 or more dyne/cm in a high reduced pressure ambient atmosphere and sealing a crevice 34, the PET film 38 in which the common transparent electrode 39 was formed on the drawing 7 (c) thermoplastics film 37 is stuck.

[0044] Drawing 7 (d) 3 **, subsequently to the transparency common electrode 39, while connecting a power source 40, by connecting a power source 40 through the drive circuit 41 to the display electrode 32, the basic configuration of a sheet mold display is completed, by impressing predetermined potential with each display electrode 32, rotation of the rotation particle 35 is controlled and an image display is performed for predetermined.

[0045] In the gestalt of this 2nd operation, since the swelling process of a transparency base material is not used, the mixing opportunity of air serves as an attachment process of ** thermoplastics film 37 like the distributed process of ** rotation particle 35, and the packer of ** translucency liquid 36, but since it is the surface tension of the critical-surface-tension > translucency liquid of a rotation particle, air does not mix in the distributed process of ** rotation particle 35.

[0046] Moreover, since air does not mix the packer of ** translucency liquid 36 in the attachment process of ** thermoplastics film 37 since it is the surface tension of the critical-surface-tension > translucency liquid of the thermoplastics film 37, and the attachment process of ** thermoplastics film 37 is especially performed under the high reduced pressure ambient atmosphere, air does not mix.

[0047] As mentioned above, although the gestalt of each operation of this invention has been explained, this invention is not restricted to the configuration and conditions which were indicated in the gestalt of each operation, and various kinds of modification is possible for it. For example, although reference is not made about the color of a rotation particle especially in the gestalt of each above-mentioned operation What is necessary is to mix a coloring agent etc. and just to form 2 color ball or a multicolor ball into the main component, according to the foreground color to need, and the above-mentioned well-known manufacture approach may be used for the manufacture approach, other well-known manufacture approaches may be used, and there is no limit in the manufacture approach.

[0048] Moreover, the main component which forms a rotation particle is not restricted to the ingredient indicated in the gestalt of operation, can use various kinds of ingredients explained in the above-mentioned conventional example, and should just choose them based on the relation of the critical surface tension to the insolubility and the liquefied transparency base material to a translucency liquid.

[0049] moreover, the gestalt of each above-mentioned operation -- setting -- a lower sheet -- SiO₂ etc. -- although constituted from a PET film of the dispersed reflexivity, it is not restricted to such a configuration and thickness may stick the cloudy opaque synthetic paper (for example, . synthetic-paper YUPO: trade name made from the formation of the Oji oil) which is about 80 micrometers on the opposite side the side which forms a display electrode using a transparent PET film.

[0050] Moreover, although the liquefied transparency base material which distributed the rotation particle is applied on the PET film in which the display electrode was formed, in the gestalt of the 1st operation of the above After applying the liquefied transparency base material which distributed the rotation particle not on the thing restricted to such a configuration but on the film made from Teflon (trademark) and performing degassing, solidification, and swelling processing, the film made from Teflon is exfoliated. Subsequently With the PET film of the pair in which the display electrode was formed, a transparency base material is inserted and may be stuck.

[0051] Moreover, although the thermoplastics film is stuck on the PET film in which the display electrode was formed, in the gestalt of the 2nd operation of the above A thermoplastics film is stuck not on the thing restricted to such a configuration but on the film made from Teflon. After performing the closure by crevice formation, restoration of the translucency liquid which

distributed the rotation particle, and the thermoplastics film, the film made from Teflon is exfoliated, and subsequently, with the PET film of the pair in which the display electrode was formed, a transparency base material is inserted and may be stuck.

[0052] Moreover, in the gestalt of each above-mentioned operation, although it is made to carry out the selection drive of the matrix-like display electrode by the drive circuit using matrix-like a display electrode and a common electrode, active components, such as TFT, are prepared in the PET film itself, and it is good also as a active-matrix mold electric paper.

[0053] Or you may constitute from a passive-matrix mold which the stripe-like display electrode which intersects perpendicularly mutually was made to counter like the conventional example shown in drawing 8.

[0054] Moreover, in the gestalt of the 2nd operation of the above, although only one kind shows the quality of the material of a rotation particle, the rotation particle of various kinds of quality of the materials can be used like the gestalt of the 2nd operation of the above. However, to use the quality of the material with small critical surface tension, it is necessary to perform degassing processing under a high vacuum more, or to cover the front face of a rotation particle with the coat which has the surface tension more than the surface tension of a translucency liquid beforehand.

[0055] Here, with reference to drawing 1, the detailed description of this invention is explained again.

Refer to drawing 1 (additional remark 1). The sheet mold display with which the critical surface tension of said rotation particle 1 and the transparency base material 4 is characterized by to be more than the surface tension of the translucency matter in the sheet mold display which consists of translucency matter 5 filled up with the cavity formed in the perimeter of the rotation particle 1 which has the fields 2 and 3 where optical properties differ mutually, and the transparency base material 4 which distributes said rotation particle 1 and said rotation particle 1.

(Additional remark 2) Sheet mold display of additional remark 1 publication with which the above-mentioned cavity is characterized by being either of the cavities formed in the cavity or the above-mentioned transparency base material 4 constituted by swelling the transparency base material 4 which distributed the above-mentioned rotation particle 1 by machining.

(Additional remark 3) Sheet mold display given in the additional remarks 1 or 2 characterized by the above-mentioned translucency matter 5 being silicone oil while the above-mentioned transparency base material 4 is constituted by silicone rubber.

(Additional remark 4) Sheet mold display of the additional remark 1 publication characterized by being silicone rubber which the above-mentioned silicone rubber constructs for which a bridge and solidifies by the addition reaction.

(Additional remark 5) After making the liquefied transparency base material 4 distribute the rotation particle 1 which has the fields 2 and 3 where optical properties differ mutually, In the manufacture approach of a sheet mold display of having the process which applies to the sheet-like member 6 and it is made solidifying, and the process which forms the cavity filled up into the perimeter of said rotation particle 1 with said translucency liquid by being immersed into a translucency liquid and making said solidified transparency base material 4 swelling The manufacture approach of the sheet mold display characterized by performing ingredient selection beforehand so that the critical surface tension of said rotation particle 1 may become more than the surface tension of said liquefied transparency base material 4.

(Additional remark 6) After making the liquefied transparency base material 4 distribute the rotation particle 1 which has the fields 2 and 3 where optical properties differ mutually, In the manufacture approach of a sheet mold display of having the process which applies to the sheet-like member 6 and it is made solidifying, and the process which forms the cavity filled up into the perimeter of said rotation particle 1 with said translucency liquid by being immersed into a translucency liquid and making said solidified transparency base material 4 swelling The manufacture approach of the sheet mold display characterized by establishing a wrap process by the coat which consists the front face of said rotation particle 1 of translucency matter which has the surface tension more than the surface tension of said liquefied transparency base

material 4 beforehand when the critical surface tension of said rotation particle 1 is smaller than the surface tension of said liquefied transparency base material 4.

(Additional remark 7) The manufacture approach of the sheet mold display according to claim 6 characterized by being the matter as the translucency liquid with which a cavity is filled up with the same above-mentioned translucency matter.

(Additional remark 8) The process which forms two or more crevices in a sheet-like transparency base material, the process filled up with the translucency liquid which made said crevice distribute the rotation particle 1 which has the fields 2 and 3 where optical properties differ mutually, In the manufacture approach of a sheet mold display of having the process which sticks a sheet-like bright film on the field in which the crevice of said sheet-like transparency base material was established The manufacture approach of the sheet mold display characterized by performing ingredient selection beforehand so that the critical surface tension of said rotation particle 1 and a sheet-like transparency base material may become more than the surface tension of said translucency liquid.

[0056]

[Effect of the Invention] according to this invention -- the critical surface tension of a rotation particle, the surface tension of a translucency liquid, and the surface tension of a liquefied transparency base material -- or Since each ingredient is chosen so that the critical surface tension of a transparency base material may fill predetermined relation Since air bubbles do not mix in the cavity which a rotation particle rotates and the rotation inhibition and scattered reflection by air bubbles do not arise The place which can manufacture with the sufficient repeatability of the sheet mold display excellent in display quality, and contributes to low-costizing of a sheet mold display and quality improvement by it is large.

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TECHNICAL FIELD

[Field of the Invention] This invention relates to the sheet mold display which has the description in the ingredient selection for making free the endocyst of the rotation of 2 color ball which made two hemispheres of a contrast color unify, without generating air bubbles in a transparency base material in the display sheet especially called an electric paper, and its manufacture approach about a sheet mold display and its manufacture approach.

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PRIOR ART

[Description of the Prior Art] In recent years, the sheet mold display which it is called a paper [an electric paper and]-like display, a digital paper, etc., a display layer is pinched between the electrode plates of a pair with the spread of information machines and equipment, and optical absorption or optical reflection is changed by impressing electric field to inter-electrode [this], and performs an image display attracts attention.

[0003] The microcapsule which colored the solvent which distributed the electrophoresis particle as a minute element which constitutes the display layer to which the optical reflection or optical absorption which constitutes such a sheet mold display is changed, and connote this solvent (if required) Refer to JP,1-86116,A and the body of revolution which doubled the semi-sphere where the both sides of a color and electrical characteristics differ, i.e., the microcapsule which connote 2 color ball, (if required) The liquid crystal / macromolecule bipolar membrane containing JP,6-226875,A, JP,8-234686,A, a U.S. Pat. No. 4,126,854 specification, referring to the U.S. Pat. No. 4,143,103 specification, or dichroic coloring matter and a smectic liquid crystal are known.

[0004] Since what is necessary is just to apply these components on the PET (polyene CHIREN terephthalate) sheet in which the electrode was formed in being able to hold image information and constitute an indicating equipment using these components , even if it has memory nature in the case of these components and there is no power source in it , it becomes the indicating equipment which has that it is thin and light and the flexibility which can be carry , and since it is a reflective mold indicating equipment , it is expect as an alternative of paper .

[0005] Since especially the indicating equipment using 2 color ball indicated by an above-mentioned U.S. Pat. No. 4,126,854 specification or an above-mentioned U.S. Pat. No. 4,143,103 specification is known as a display in which the contrast property which was excellent compared with other methods is shown, here explains an example of the electric paper using the conventional 2 color ball with reference to drawing 8 .

[0006] Drawing 8 reference drawing 8 is the notional block diagram of the electric paper using the conventional 2 color ball. After applying the silicone rubber 54 with which each diameter which united the black semi-sphere 52 and the white semi-sphere 53 with the PET film 56 in which the display electrode 58 was formed serves as a host layer who distributed 2 color ball 51 which is 10 micrometers – about 300 micrometers, After carrying out self-formation of the globular form cavity which connote 2 color ball 51 near the 2 color ball 51 by solidifying silicone rubber 54, being immersed subsequently to the inside of silicone oil, and making silicone rubber 54 swell, The PET film 55 in which the display electrode 59 was formed is stuck so that stripe-like the display electrode 58 and the display electrode 59 may carry out an abbreviation rectangular cross mutually, and the inside of the cavity formed of swelling is filled with the silicone oil 57 which is dielectric liquid.

[0007] In this case, it rotates in the cavity where 2 color ball 51 was filled with silicone oil 57 according to the polarity of that electric field when the electrical potential difference was impressed between the display electrode 58 and 59, since the black semi-sphere 52 was just charged although it was neutrality electrically in the 2 color ball 51 whole, and the white semi-sphere 53 was charged in negative on the other hand, and the information on predetermined to a

watcher is displayed. That is, although 2 color ball 51 self is also a dielectric and neutrality electrically macroscopically, it is the electric duplex layer which consists of two-layer [of the polar charge which conflicts microscopically].

[0008] Since this electric paper resembles paper and it has the ambient light adjustment operation like paper, the reflected light becomes strong as an ambient light becomes bright, and this electric paper much more becomes easy to appear.

[0009] Moreover, it becomes possible by there being flexibility like paper, being able to carry like paper, and impressing an electrical potential difference to the display electrodes 58 and 59 further to write in and copy like paper.

[0010] Two kinds from which the color which consists of what various kinds of approaches are proposed as the manufacture approach of such a 2 color ball, i.e., a rotation particle, for example, added carbon black to carnauba wax, and a thing which added titanium oxide differs of fused waxes are combined, and there is the approach (if required, refer to U.S. Pat. No. 5,262,098 specification) of making solidify, after conglobating with surface tension, and using as 2 color ball.

[0011] Moreover, the method (if required, refer to JP,11-85069,A or JP,11-161206,A) of making a toner and a silver halide the semi-sphere front face of one side of the particle of light transmission nature which consists of glass or resin adhere [a semi-sphere front face] to the ball which consists of photoconductivity ingredients, such as the approach (refer to JP,11-85067,A or JP,11-85068,A if required) of vapor-depositing and applying a metal, carbon black, or an antimony sulfide, or a zinc oxide, a hydrophilic giant molecule, alternatively etc. is learned.

[0012] Moreover, the ingredient which constitutes rotation particles, such as resin, a wax, or a coloring agent, besides the above-mentioned manufacture approach is changed variously, and 2 color ball is rotated by low energy by enlarging the polar difference of two unique semi-spheres which constitute 2 color ball etc., it is high resolving, and it is tried so that a good display can already be performed by responsibility.

[0013] Furthermore, as such a rotation particle, the multicolor ball corresponding to multiple-colorizing distinguished by different color with in three colors or four colors in addition to above-mentioned 2 color ball is also proposed.

[0014] As a main component which constitutes such a rotation particle, although resin, such as polystyrene, the poly acrylic, and polyethylene, and inorganic materials, such as glass, are sufficient, the easy matter of the controllability of the viewpoint of manufacture ease to a configuration, classification by color, and an electrification controllability is desirable.

[0015] Moreover, from a viewpoint of movement controllabilities, such as rotation, a halt, etc. of a rotation particle, in addition to the ease of an electrification controllability and the controllability of a configuration or magnitude, specific gravity also needs to become important, and chemical stability also needs to be still more important, and when manufacturing a sheet mold display as mentioned above especially using swelling, it is necessary to be the matter with an interaction small insoluble into translucency liquids, such as silicone oil -- it can ignore.

[0016] As small matter of such an interaction, molecular weight is 50000 or less. The wax-like matter whose specific gravity is 0.70-1.20 is suitable. For example, higher fatty acids, such as stearin acid, a palmitic acid, a myristic acid, and a lauric acid Higher-fatty-acid metal salts, such as aluminum stearate, a stearin acid potassium, and palmitic-acid zinc, The derivatives of higher fatty acids, such as hydrogenation castor oil, cocoa fat, methyl hydroxystearate, and glycerol mono-hydroxystearate Haze wax, beeswax, carnauba wax, a micro crystallin wax, An olefin polymer, copolymers, etc. of low molecular weight, such as wax [, such as paraffin wax,], polyethylene, polypropylene, ethylene-vinylacetate copolymer, and ethylene-vinyl alkyl ether, are mentioned.

[0017] An above-mentioned sheet mold display is obtained by distributing the rotation particle which makes these matter the main component to elastomers (elastomer), such as a base material, for example, silicone rubber etc., and constituting a cavity.

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EFFECT OF THE INVENTION

[Effect of the Invention] according to this invention -- the critical surface tension of a rotation particle, the surface tension of a translucency liquid, and the surface tension of a liquefied transparency base material -- or Since each ingredient is chosen so that the critical surface tension of a transparency base material may fill predetermined relation Since air bubbles do not mix in the cavity which a rotation particle rotates and the rotation inhibition and scattered reflection by air bubbles do not arise The place which can manufacture with the sufficient repeatability of the sheet mold display excellent in display quality, and contributes to low-costizing of a sheet mold display and quality improvement by it is large.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, when displayed by manufacturing the sheet mold indicating equipment using the above-mentioned 2 color ball, impressing an electrical potential difference to a display electrode, and rotating 2 color ball, it reflected irregularly, many what have difficult recognition of a color, and unstable 2 color balls of rotation behavior were generated, and the problem that display image quality deteriorated occurred.

[0019] When the cause of a fall of such display image quality was considered wholeheartedly, it solved air bubbles mixing in some cavities in a sheet, and these air bubbles checking rotation of 2 color ball, and having become the cause of scattered reflection.

[0020] Therefore, this invention aims at preventing that air bubbles mix into a cavity and improving display image quality.

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MEANS

[Means for Solving the Problem] Although here explains The means for solving a technical problem in this invention with reference to drawing 1, the signs 7 and 8 in drawing are display electrodes.

In order to attain the drawing 1 referring-to-above-mentioned purpose, this invention The silicone rubber which distributes the rotation particle 1 which has the fields 2 and 3 where optical properties differ mutually, and the rotation particle 1, In the sheet mold display which consists of translucency matter 5, such as silicone oil filled up with the cavity formed in the perimeter of the transparency base materials 4, such as silicone rubber especially constructed for which a bridge and solidified by the addition reaction, and the rotation particle 1 Critical surface tension of rotation particle 1 ingredient and the transparency base material 4 is characterized by being more than the surface tension of the translucency matter 5.

[0022] Thus, by making into the surface tension of rotation particle 1 ingredient and the critical-surface-tension \geq translucency matter 5 of the transparency base material 4 relation of the critical surface tension of rotation particle 1 ingredient which constitutes a sheet mold display, and the transparency base material 4, and the surface tension of the translucency matter 5 Since the concordance nature between ingredients increases, and the rotation particle 1 and the transparency base material 4 do not flip the translucency matter 5, therefore atmospheric air does not mix at the process of distribution or restoration, air bubbles do not mix in a cavity.

[0023] After such a sheet mold display makes the liquefied transparency base material 4 distribute the rotation particle 1 which has the fields 2 and 3 where optical properties differ mutually, the sheet-like member 6 is made to apply and solidify it. Subsequently The cavity filled up into the perimeter of the rotation particle 1 with said translucency liquid by being immersed into a translucency liquid and making the solidified transparency base material 4 swell may be formed and constituted. In this case By performing ingredient selection beforehand so that the critical surface tension of the rotation particle 1 may become more than the surface tension of the liquefied transparency base material 4, atmospheric air does not mix the rotation particle 1 at the process which the liquefied transparency base material 4 is made to distribute.

[0024] In addition, when the critical surface tension of the rotation particle 1 is smaller than the surface tension of the liquefied transparency base material 4, the smallness of the critical surface tension of the rotation particle 1 can be compensated by it that what is necessary is just to make it distribute after covering the front face of the rotation particle 1 beforehand by the translucency matter 5 of the surface tension more than the surface tension of the liquefied transparency base material 4.

[0025] After a sheet mold display forms two or more crevices in a sheet-like transparency base material, it is filled up with the translucency liquid which made the crevice distribute the rotation particle 1 which has the fields 2 and 3 where optical properties differ mutually. Moreover, subsequently In the field in which the crevice of a sheet-like transparency base material was established, a sheet-like bright film is stuck and may be constituted. In this case Atmospheric air does not mix the translucency liquid which distributed the rotation particle 1 at the process with which a crevice is filled up by performing ingredient selection beforehand so that the critical surface tension of the rotation particle 1 and a sheet-like transparency base material may

become more than the surface tension of said translucency liquid.

[0026] Moreover, as a liquefied transparency base material 4, silicone oil is suitable and the silicone rubber especially constructed for which a bridge and solidified by the addition reaction is suitable. For example, in the case of the silicone rubber solidified by the condensation reaction, alcohol, an acetone steam, etc. occur in the case of a condensation reaction, and there is a possibility of becoming the cause of air bubbles in it.

[0027]

[Embodiment of the Invention] Here, with reference to drawing 2 thru/or drawing 4, the manufacture approach of the sheet mold display of the gestalt operation of the 1st of this invention is explained.

Drawing 2 (a) 3 **, first, after distributing the 50–200-micrometer rotation particle 12, while particle size forms more suitably 10–300 micrometers of display electrodes 14 in the liquefied transparency base material 11 which consists of 2 acidity-or-alkalinity RTV silicone rubber KE109 (trade name made from the Shin-etsu chemistry) used as a sheet-like transparency base material, it is SiO₂. It applies on the PET film 13 which mixed and opacified the particle.

[0028] In this case, as a rotation particle 12, the product made of an unsaturated polyester resin, the product made of acrylic resin, and three kinds of rotation particles made of polystyrene resin were prepared. The surface tension of the liquefied transparency base material 11 and the critical surface tension of the rotation particle 12 are measured beforehand, the surface tension of 2 acidity-or-alkalinity RTV silicone rubber KE109 was 21 dyne/cm here, and the critical surface tension of an unsaturated polyester resin was [the critical surface tension of 39 dyne/cm and polystyrene resin of the critical surface tension of 43 dyne/cm and acrylic resin] 33 dyne/cm.

[0029] Here, the measuring method of the critical surface tension of the rotation particle 12, i.e., solid surface tension, is explained with reference to drawing 4.

Drawing 4 (a) 3 **, first, some kinds of liquids 23 with which surface tension differs mutually are dropped at the measured ingredient 22 which processed the measured ingredient 22 in the shape of a sheet, and was processed in the shape of [this] a sheet, and that contact angle theta is measured.

[0030] Drawing 4 (b) 3 **, subsequently, each measured contact angle theta is plotted to the surface tension of a liquid 22, and the surface tension gamma set to costheta=1 by inclination extrapolation is defined as critical surface tension of the measured ingredient 23.

[0031] Drawing 2 (b) Subsequently, after carrying out indirect desulfurization bubble processing for 1 minute in a reduced pressure ambient atmosphere, for example, the reduced pressure ambient atmosphere of 0.95MPa, it is left in a room temperature for 48 hours, the liquefied transparency base material 11 is stiffened according to bridge formation by the addition reaction, and it takes 3 ** for the transparency base material 15. In this condition, the opening does not exist in the perimeter of the rotation particle 12. In addition, incidentally the critical surface tension of the hardened transparency base material 15 is 25 dyne/cm.

[0032] Drawing 3 (c) Subsequently to the inside of the silicone oil SH200–20 translucency liquid 16 which consists of cS (Dow Corning Toray Silicone trade name), this sheet is immersed for 24 hours and the transparency base material 15 is made to swell 3 **. In this case, to the translucency liquid 16, since [insoluble or] absorptivity is very low, an opening will be formed in the perimeter of the rotation particle 12, the translucency liquid 16 will enter this opening, and the rotation particle 12 will be filled with the translucency liquid 17.

[0033] Drawing 3 (d) 3 **, subsequently, after sticking the transparency PET film 18 which formed the transparency common electrode 19 which consists of ITO, while connecting a power source 20 to the transparency common electrode 19 By connecting a power source 20 through the drive circuit 21 to the display electrode 14, the basic configuration of a sheet mold display is completed, by impressing predetermined potential with each display electrode 14, rotation of the rotation particle 12 is controlled and an image display is performed for predetermined.

[0034] Thus, as a result of investigating the existence of the air bubbles in the translucency liquid 17 which fills an opening about the manufactured sheet mold display, i.e., scattered reflection nature, and rotation inhibition, as for rotation inhibition and scattered reflection,

neither of the cases was seen.

[0035] Moreover, since scattered reflection was seen as a rotation particle 12 although rotation inhibition was not seen when critical surface tension used the polyvinylidene fluoride resin of 22 dyne/cm, in an above-mentioned degassing process, scattered reflection is no longer seen by performing degassing processing in the high vacuum of 0.08 or more MPas.

[0036] Moreover, although rotation inhibition was seen and it was unsuitable as a rotation particle 12 when critical surface tension used the Pori polytetrafluoroethylene resin (PTFE) polyvinylidene fluoride resin of 18.5 dyne/cm In the process which distributes the rotation particle 12 in the liquefied transparency base material 11, rotation inhibition ceased to be seen by immersing surface tension in the translucency liquid of 21 or more dyne/cm beforehand in the rotation particle 12, covering the front face of the rotation particle 12 with the high surface tension film, and performing a degassing process in a high vacuum.

[0037] Drawing 5 reference drawing 5 summarizes the above-mentioned result, and a PTFE film is used for it as a sheet-like transparency base material for a comparison. The crevice which pushes in this PTFE film by machining and consists of a gap is formed. After filling up this crevice with the translucency liquid which consists of silicone oil SH200-20cS (Dow Corning Toray Silicone trade name) which distributed the rotation particle, The example of a comparison (examples 3-7 of a comparison) which stuck a new PTFE film on the side which prepared the crevice is also doubled and shown, and the rotation particle which consists of five kinds of above-mentioned resin as a rotation particle in this case was used. In the case of these examples 3-7 of a comparison, rotation inhibition was seen in all.

[0038] When the above is considered from a viewpoint of critical surface tension and surface tension, from the gestalt of operation, and contrast of the examples 1 and 2 of a comparison Between the critical surface tension of the rotation particle 12, and the surface tension of the liquefied transparency base material 11 The relation of the surface tension of the critical-surface-tension \geq liquefied transparency base material 11 of the rotation particle 12 is required, and by filling this relation, in the distributed process of the rotation particle 12, since the rotation particle 12 does not flip a liquefied transparency base material, it is lost that air bubbles mix.

[0039] However, since it becomes easy to mix air bubbles like gestalt ** of operation as mentioned above in the case of extent a little with the larger critical surface tension of the rotation particle 12 than the surface tension of the liquefied transparency base material 11, it is necessary to perform degassing processing in a high vacuum and, and like gestalt ** of operation, when the critical surface tension of the rotation particle 12 is smaller than the surface tension of the liquefied transparency base material 11, it is necessary to cover with the high surface tension film beforehand.

[0040] In addition, in order that in the case of the examples 3-7 of a comparison atmospheric air may mix in case the crevice established in the PTFE sheet is filled up with the silicone oil which distributed the rotation particle since it has surface tension of the surface tension < translucency liquid of a sheet-like transparency base material, it is thought that air bubbles mix in a cavity.

[0041] Next, with reference to drawing 6 and drawing 7 , the production process of the sheet mold display of the gestalt of operation of the 2nd of this invention is explained.

Drawing 6 (a) SiO₂ which formed the display electrode 32 first 3 ** Critical surface tension sticks the 20 dynes [/cm] or more thermoplastics film 33 on the PET film 31 which distributed the particle, and the crevice 34 which pushes in by mechanical processing and consists of a gap is formed.

[0042] Drawing 6 (b) 3 **, subsequently, critical surface tension trickles the rotation particle 36 of 20 or more dyne/cm, for example, the translucency liquid which consists of silicone oil SH200-20cS (Dow Corning Toray Silicone trade name) which critical surface tension made distribute the rotation particle 35 which consists of an unsaturated polyester resin of 43 dyne/cm, and a crevice 34 is filled up with the rotation particle 35 and the translucency liquid 36.

[0043] 3 **, subsequently, after critical surface tension's sticking the thermoplastics film 37 of 20 or more dyne/cm in a high reduced pressure ambient atmosphere and sealing a crevice 34,

the PET film 38 in which the common transparent electrode 39 was formed on the drawing 7 (c) thermoplastics film 37 is stuck.

[0044] Drawing 7 (d) 3 **, subsequently to the transparency common electrode 39, while connecting a power source 40, by connecting a power source 40 through the drive circuit 41 to the display electrode 32, the basic configuration of a sheet mold display is completed, by impressing predetermined potential with each display electrode 32, rotation of the rotation particle 35 is controlled and an image display is performed for predetermined.

[0045] In the gestalt of this 2nd operation, since the swelling process of a transparency base material is not used, the mixing opportunity of air serves as an attachment process of ** thermoplastics film 37 like the distributed process of ** rotation particle 35, and the packer of ** translucency liquid 36, but since it is the surface tension of the critical-surface-tension > translucency liquid of a rotation particle, air does not mix in the distributed process of ** rotation particle 35.

[0046] Moreover, since air does not mix the packer of ** translucency liquid 36 in the attachment process of ** thermoplastics film 37 since it is the surface tension of the critical-surface-tension > translucency liquid of the thermoplastics film 37, and the attachment process of ** thermoplastics film 37 is especially performed under the high reduced pressure ambient atmosphere, air does not mix.

[0047] As mentioned above, although the gestalt of each operation of this invention has been explained, this invention is not restricted to the configuration and conditions which were indicated in the gestalt of each operation, and various kinds of modification is possible for it. For example, although reference is not made about the color of a rotation particle especially in the gestalt of each above-mentioned operation What is necessary is to mix a coloring agent etc. and just to form 2 color ball or a multicolor ball into the main component, according to the foreground color to need, and the above-mentioned well-known manufacture approach may be used for the manufacture approach, other well-known manufacture approaches may be used, and there is no limit in the manufacture approach.

[0048] Moreover, the main component which forms a rotation particle is not restricted to the ingredient indicated in the gestalt of operation, can use various kinds of ingredients explained in the above-mentioned conventional example, and should just choose them based on the relation of the critical surface tension to the insolubility and the liquefied transparency base material to a translucency liquid.

[0049] moreover, the gestalt of each above-mentioned operation -- setting -- a lower sheet -- SiO₂ etc. -- although constituted from a PET film of the dispersed reflexivity, it is not restricted to such a configuration and thickness may stick the cloudy opaque synthetic paper (for example, . synthetic-paper YUPO: trade name made from the formation of the Oji oil) which is about 80 micrometers on the opposite side the side which forms a display electrode using a transparent PET film.

[0050] Moreover, although the liquefied transparency base material which distributed the rotation particle is applied on the PET film in which the display electrode was formed, in the gestalt of the 1st operation of the above After applying the liquefied transparency base material which distributed the rotation particle not on the thing restricted to such a configuration but on the film made from Teflon (trademark) and performing degassing, solidification, and swelling processing, the film made from Teflon is exfoliated. Subsequently With the PET film of the pair in which the display electrode was formed, a transparency base material is inserted and may be stuck.

[0051] Moreover, although the thermoplastics film is stuck on the PET film in which the display electrode was formed, in the gestalt of the 2nd operation of the above A thermoplastics film is stuck not on the thing restricted to such a configuration but on the film made from Teflon. After performing the closure by crevice formation, restoration of the translucency liquid which distributed the rotation particle, and the thermoplastics film, the film made from Teflon is exfoliated, and subsequently, with the PET film of the pair in which the display electrode was formed, a transparency base material is inserted and may be stuck.

[0052] Moreover, in the gestalt of each above-mentioned operation, although it is made to carry

out the selection drive of the matrix-like display electrode by the drive circuit using matrix-like a display electrode and a common electrode, active components, such as TFT, are prepared in the PET film itself, and it is good also as a active-matrix mold electric paper.

[0053] Or you may constitute from a passive-matrix mold which the stripe-like display electrode which intersects perpendicularly mutually was made to counter like the conventional example shown in drawing 8.

[0054] Moreover, in the gestalt of the 2nd operation of the above, although only one kind shows the quality of the material of a rotation particle, the rotation particle of various kinds of quality of the materials can be used like the gestalt of the 2nd operation of the above. However, to use the quality of the material with small critical surface tension, it is necessary to perform degassing processing under a high vacuum more, or to cover the front face of a rotation particle with the coat which has the surface tension more than the surface tension of a translucency liquid beforehand.

[0055] Here, with reference to drawing 1, the detailed description of this invention is explained again.

Refer to drawing 1 (additional remark 1). The sheet mold display with which the critical surface tension of said rotation particle 1 and the transparency base material 4 is characterized by to be more than the surface tension of the translucency matter in the sheet mold display which consists of translucency matter 5 filled up with the cavity formed in the perimeter of the rotation particle 1 which has the fields 2 and 3 where optical properties differ mutually, and the transparency base material 4 which distributes said rotation particle 1 and said rotation particle 1.

(Additional remark 2) Sheet mold display of additional remark 1 publication with which the above-mentioned cavity is characterized by being either of the cavities formed in the cavity or the above-mentioned transparency base material 4 constituted by swelling the transparency base material 4 which distributed the above-mentioned rotation particle 1 by machining.

(Additional remark 3) Sheet mold display given in the additional remarks 1 or 2 characterized by the above-mentioned translucency matter 5 being silicone oil while the above-mentioned transparency base material 4 is constituted by silicone rubber.

(Additional remark 4) Sheet mold display of the additional remark 1 publication characterized by being silicone rubber which the above-mentioned silicone rubber constructs for which a bridge and solidifies by the addition reaction.

(Additional remark 5) After making the liquefied transparency base material 4 distribute the rotation particle 1 which has the fields 2 and 3 where optical properties differ mutually, In the manufacture approach of a sheet mold display of having the process which applies to the sheet-like member 6 and it is made solidifying, and the process which forms the cavity filled up into the perimeter of said rotation particle 1 with said translucency liquid by being immersed into a translucency liquid and making said solidified transparency base material 4 swelling The manufacture approach of the sheet mold display characterized by performing ingredient selection beforehand so that the critical surface tension of said rotation particle 1 may become more than the surface tension of said liquefied transparency base material 4.

(Additional remark 6) After making the liquefied transparency base material 4 distribute the rotation particle 1 which has the fields 2 and 3 where optical properties differ mutually, In the manufacture approach of a sheet mold display of having the process which applies to the sheet-like member 6 and it is made solidifying, and the process which forms the cavity filled up into the perimeter of said rotation particle 1 with said translucency liquid by being immersed into a translucency liquid and making said solidified transparency base material 4 swelling The manufacture approach of the sheet mold display characterized by establishing a wrap process by the coat which consists the front face of said rotation particle 1 of translucency matter which has the surface tension more than the surface tension of said liquefied transparency base material 4 beforehand when the critical surface tension of said rotation particle 1 is smaller than the surface tension of said liquefied transparency base material 4.

(Additional remark 7) The manufacture approach of the sheet mold display according to claim 6 characterized by being the matter as the translucency liquid with which a cavity is filled up with

the same above-mentioned translucency matter.

(Additional remark 8) The process which forms two or more crevices in a sheet-like transparency base material, the process filled up with the translucency liquid which made said crevice distribute the rotation particle 1 which has the fields 2 and 3 where optical properties differ mutually, In the manufacture approach of a sheet mold display of having the process which sticks a sheet-like bright film on the field in which the crevice of said sheet-like transparency base material was established The manufacture approach of the sheet mold display characterized by performing ingredient selection beforehand so that the critical surface tension of said rotation particle 1 and a sheet-like transparency base material may become more than the surface tension of said translucency liquid.

[Translation done.]

*** NOTICES ***

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1. This document has been translated by computer. So the translation may not reflect the original precisely.
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3. In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the explanatory view of the theoretic configuration of this invention.

[Drawing 2] It is the explanatory view of the production process to the middle of the sheet mold display of the gestalt of operation of the 1st of this invention.

[Drawing 3] It is the explanatory view of the production process after **drawing 2** of the sheet mold display of the gestalt of operation of the 1st of this invention.

[Drawing 4] It is the explanatory view of the measuring method of critical surface tension.

[Drawing 5] It is the explanatory view of the display property in the gestalt of operation of the 1st of this invention.

[Drawing 6] It is the explanatory view of the production process to the middle of the sheet mold display of the gestalt of operation of the 2nd of this invention.

[Drawing 7] It is the explanatory view of the production process after **drawing 6** of the sheet mold display of the gestalt of operation of the 2nd of this invention.

[Drawing 8] It is the rough important section sectional view of the conventional sheet mold display.

[Description of Notations]

1 Rotation Particle

2 Field Where Optical Properties Differ

3 Field Where Optical Properties Differ

4 Transparency Base Material

5 Translucency Matter

6 Sheet-like Member

7 Display Electrode

8 Display Electrode

11 Liquefied Transparency Base Material

12 Rotation Particle

13 PET Film

14 Display Electrode

15 Transparency Base Material

16 Translucency Liquid

17 Translucency Liquid

18 Transparency PET Film

19 Transparency Common Electrode

20 Power Source

21 Drive Circuit

22 Measured Ingredient

23 Liquid

31 PET Film

32 Display Electrode

33 Thermoplastics Film

34 Crevice

- 35 Rotation Particle
- 36 Translucency Liquid
- 37 Thermoplastics Film
- 38 PET Film
- 39 Transparency Common Electrode
- 40 Power Source
- 41 Drive Circuit
- 51 2 Color Ball
- 52 Black Semi-sphere
- 53 White Semi-sphere
- 54 Silicone Rubber
- 55 PET Film
- 56 PET Film
- 57 Silicone Oil
- 58 Display Electrode
- 59 Display Electrode

[Translation done.]

*** NOTICES ***

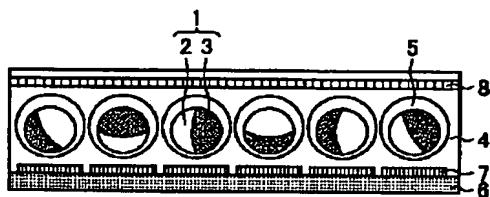
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DRAWINGS

[Drawing 1]

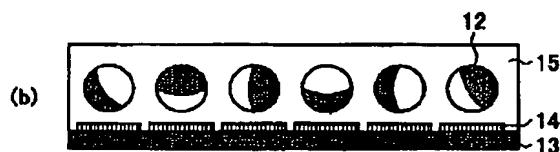
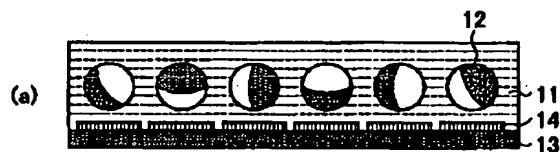
本発明の原理的構成の説明図



1:回転粒子	5:透光性物質
2:光学特性が異なる領域	6:シート状部材
3:光学特性が異なる領域	7:表示電極
4:透明基材	8:表示電極

[Drawing 2]

本発明の第1の実施の形態のシート型表示装置の途中までの
製造工程の説明図



11:波状透明基材
12:回転粒子
13:PETフィルム

14:表示電極
15:透明基材

[Drawing 5]

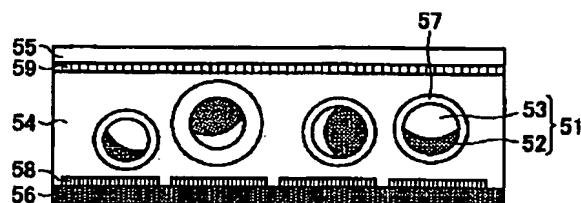
本発明の第1の実施の形態における表示特性の説明図

	基材	表面張力	付加処理	回転粒子	表面張力	結果
実施の形態①	シリコーンゴム	25		不飽和ポリエステル樹脂	43	○
実施の形態②	シリコーンゴム	25		アクリル樹脂	39	○
実施の形態③	シリコーンゴム	25		ポリスチレン樹脂	33	○
比較例①	シリコーンゴム	25		ポリフッ化ビニリデン樹脂	22	△
実施の形態④	シリコーンゴム	25	脱泡	ポリフッ化ビニリデン樹脂	22	○
比較例②	シリコーンゴム	25		PTFE	18.5	×
実施の形態⑤	シリコーンゴム	25	接着	PTFE	18.5	○
比較例③	PTFE	18.5		不飽和ポリエステル樹脂	43	×
比較例④	PTFE	18.5		アクリル樹脂	39	×
比較例⑤	PTFE	18.5		ポリスチレン樹脂	33	×
比較例⑥	PTFE	18.5		ポリフッ化ビニリデン樹脂	22	×
比較例⑦	PTFE	18.5		PTFE	18.5	×

(但し、シリコーンオイルの表面張力は20dyne/cm)

[Drawing 8]

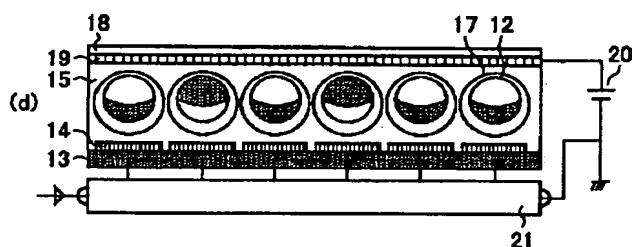
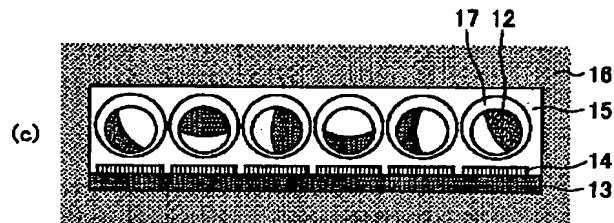
従来のシート型表示装置の概略的要部断面図



51:2色ボール	56:PETフィルム
52:黒色半球	57:シリコーンオイル
53:白色半球	58:表示電極
54:シリコーンゴム	59:表示電極
55:PETフィルム	

[Drawing 3]

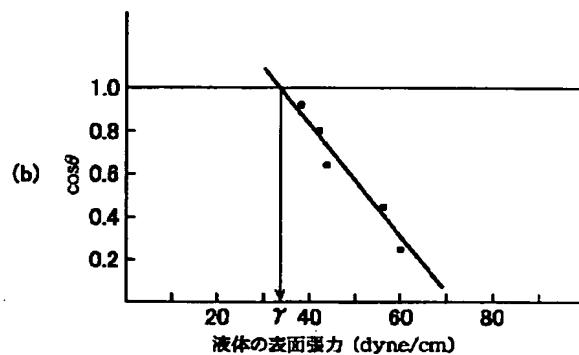
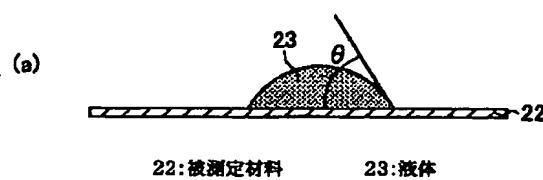
本発明の第1の実施の形態のシート型表示装置の図2以降の
製造工程の説明図



12:回転粒子	17:透光性液体
13:PETフィルム	18:PETフィルム
14:表示電極	19:透明共通電極
15:透明基材	20:電源
16:透光性液体	21:駆動回路

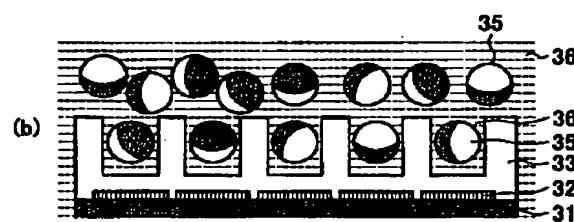
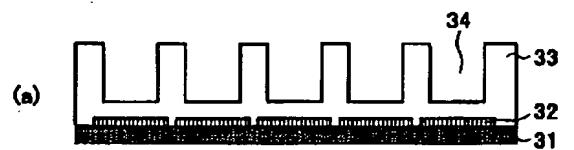
[Drawing 4]

臨界表面張力の測定方法の説明図



[Drawing 6]

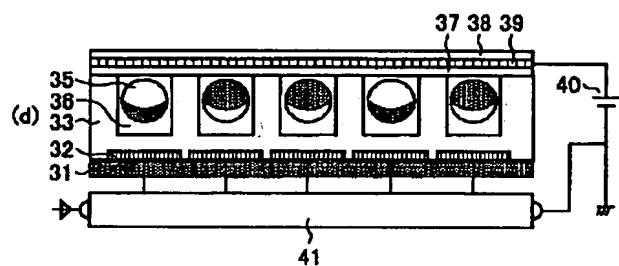
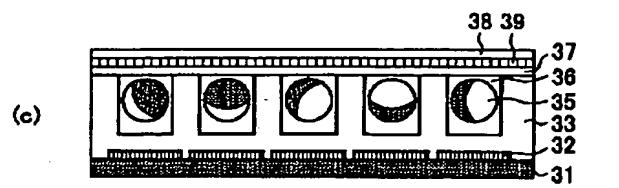
本発明の第2の実施の形態のシート型表示装置の途中までの
製造工程の説明図



31:PETフィルム 34:凹部
32:表示電極 35:回転粒子
33:熱可塑性樹脂フィルム 36:透光性液体

[Drawing 7]

本発明の第2の実施の形態のシート型表示装置の図6以降の
製造工程の説明図



31:PETフィルム	37:熱可塑性樹脂フィルム
32:表示電極	38:PETフィルム
33:熱可塑性樹脂フィルム	39:共通透明電極
35:回転粒子	40:電源
36:透光性液体	41:駆動回路

[Translation done.]